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The New Permian–Triassic Paleomagnetic Pole for the East European Platform Corrected for Inclination Shallowing

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Abstract—The results of detailed paleomagnetic studies in seven Upper Permian and Lower Triassic reference sections of East Europe (Middle Volga and Orenburg region) and Central Germany are presented. For each section, the coefficient of inclination shallowing *f* (King, 1955) is estimated by the Elongation–Inclination (E–I) method (Tauxe and Kent, 2004) and is found to vary from 0.4 to 0.9. The paleomagnetic directions, corrected for the inclination shallowing, are used to calculate the new Late Permian–Early Triassic paleomagnetic pole for the East European Platform (N = 7, PLat = 52.1°, PLong = 155.8°, A95 = 6.6°). Based on this pole, the geocentric axial dipole hypothesis close to the Paleozoic/Mesozoic boundary is tested by the single plate method. The absence of the statistically significant distinction between the obtained pole and the average Permian–Triassic (P–Tr) paleomagnetic pole of the Siberian Platform and the coeval pole of the North American Platform corrected for the opening of the Atlantic (Shatsillo et al., 2006) is interpreted by us as evidence that ~250 Ma the configuration of the magnetic field of the Earth was predominantly dipolar; i.e., the contribution of nondipole components was at most 10% of the main magnetic field. In our opinion, the hypothesis of the nondipolity of the geomagnetic field at the P–Tr boundary, which has been repeatedly discussed in recent decades (Van der Voo and Torsvik, 2001; Bazhenov and Shatsillo, 2010; Veselovskiy and Pavlov, 2006), resulted from disregarding the effect of inclination shallowing in the paleomagnetic determinations from sedimentary rocks of "stable" Europe (the East European platform and West European plate).

Keywords: paleomagnetism, inclination shallowing, Permian, Triassic, Elongation–Inclination method, paleomagnetic pole, East European platform

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INTRODUCTION

Due to a number of properties, the Permian–Triassic (P–Tr) sedimentary sections of the Russian plate are unique, due to which they are used as stratotypes in the development of an international stratigraphic scale. However, the uniqueness of these sections for us primarily lies in the fact that in the 1950s, these sections were the first study object for the Russian paleomagnetologists leaded by Alexey N. Khramov and served as a basis for the first magnetic polarity scales. The data about the paleomagnetism of these deposits were presented in Khramov's book "Paleomagnetic Correlation of Sedimentary Strata" (Khramov, 1958); subsequently, the paleomagnetism and magnetostratigraphy of the P–Tr formations of the Russian plate were addressed in many papers and books, including those authored by the leading Russian and foreign paleomagnetologists. Today, 60 years after publishing the first paleomagnetic results for the Permian and Triassic of East Europe, we present the results of revisiting the paleomagnetology of several reference sections of these deposits; they are the first published results that have taken the effect of inclination shallowing into consideration. All the presented paleomagnetic determinations have been obtained in accordance with the modern standards regarding the quality of laboratory processing and representation of the data.

The statistically significant distinction of the average Late Permian–Early Triassic (P_3–Tr_1) paleomagnetic poles of the Siberian and East European platforms, which were parts of Laurussia in Late Paleozoic and were considered as a single lithospheric plate for that geological time, raised, inter alia, the question about the validity of the geocentric axial dipole hypothesis for the Paleozoic/Mesozoic boundary. This question has been actively debated in the paleo-